Original Article

Food Insecurity Among Overweight/Obese Patients With Non-alcoholic Fatty Liver Disease (NAFLD) in Iran: Demographic and Anthropometric Factors (A Cross-sectional Study)

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Abstract

Background: Food insecurity is a common issue in both developing and developed countries and is associated with numerous chronic disorders such as hyperlipidemia, heart disease, hypertension, and metabolic syndrome. This study aimed to explore the relationship between food insecurity and demographic and nutritional parameters in patients with non-alcoholic fatty liver disease (NAFLD).

Methods: A cross-sectional study was conducted, involving 338 obese and overweight patients with NAFLD. A valid and reliable questionnaire was used to collect demographic information, including age, gender, household size, employment, income, and education. Anthropometric assessments were conducted, and food insecurity was investigated using a validated questionnaire. Furthermore, statistical assays were performed by SPSS version 16.

Results: The study found that 18.34% of patients have low food security, while 12.72% experienced very low food security. Female gender, higher family size, lower educational attainment, lower income, and non-employed status were identified as significant determinants of food insecurity among patients with NAFLD ($P<0.05$). Moreover, patients with food insecurity tended to be older and consumed higher amounts of grain and cereals but lower amounts of fruits, vegetables, dairy, and meat. In a stepwise multivariate regression model, higher weight was a positive predictor of food insecurity ($P=0.04$), while higher educational attainment and household income exhibited protective effects against food insecurity ($P<0.01$).

Conclusion: This study revealed the role of age, gender, income, and education in developing food insecurity in patients with NAFLD. Further research is needed to confirm these results.

Keywords: Food insecurity, NAFLD, Demographic parameters

Introduction

Non-alcoholic fatty liver disease (NAFLD) encompasses a range of liver abnormalities characterized by the accumulation of large fat droplets on the liver cells.[1] This excess fat storage increases the liver's vulnerability to inflammation and fibrosis.[2] It is considered a hepatic complication of metabolic syndrome and is highly correlated with obesity, diabetes, and cardiovascular disorders.[3] The prevalence of NAFLD in developed countries is estimated to be up to 30% in the general population, with even higher rates among individuals with obesity, morbid obesity, and type 2 diabetes mellitus.[4] In Asia, approximately 29.6% of the general population is affected by NAFLD.[5]

Food insecurity, which refers to limited access to nutritious foods or disability to obtain food, is a common health issue worldwide.[6] Food insecurity has numerous negative health consequences on individuals, including reduced food variety, high consumption of energy-dense foods, and low intake of balanced meals or skipping meals, which are common among individuals from food-insecure households.[7] Low intakes of fruits and vegetables and limited access to micronutrients, including vitamins and minerals, are frequently reported in food insecure individuals. These unhealthy food habits, along with a poor lifestyle, could be potent determinants in the development of chronic diseases such as diabetes, hypertension, or cardiovascular disease.[8]

Limited research exists on the association between food insecurity and chronic diseases, and our review of the literature found no study investigating food insecurity and its determinants among patients with NAFLD. Since NAFLD is closely associated with diabetes and obesity and is part of this cluster of chronic diseases, it is necessary to evaluate the food insecurity prevalence and its determinants among these patients. Accordingly, this study aimed to investigate different stages of food insecurity and its socioeconomic and nutritional determinants among overweight or obese patients with NAFLD.

Methods

Study Design

This cross-sectional study was conducted among patients aged over 25 years with NAFLD who had body mass index (BMI) greater than 25 kg/m^2. Participants were referred to the Imam Reza Hospital and Sheykholrais Polyclinic in northwest Iran between April and August 2022. The physician diagnosed the disease based on liver ultrasonography findings. Written informed consent was obtained from participants, and they were provided with information about the study. Demographic information, including age, gender, household number, employment, income, and education level was collected by interviewer-administered questionnaires. Patients with other hepatic disorders such as hepatitis and cirrhosis, being on special diets, pregnancy, and lactation were excluded.

Anthropometric and Dietary Assessments

Weight and height were measured via standard methods, and BMI was calculated. Obesity status was classified according to the World Health Organization (WHO) criteria.[9] Waist circumference (WC) was measured using a tape measure by determining the distance between the lower costal border and the iliac crest, precisely at the midway point. Dietary intake was evaluated using a 132-item food frequency questionnaire (FFQ).[10] Subjects were asked about the frequency of consuming different food groups, including fruits, vegetables, fish, grains, legumes, cereals, meat, and dairy products.

Assessment of Food Insecurity

A valid and reliable short six-item questionnaire was used for food security assessment. Scores were classified as high food security (HFS) with all-negative or only one positive answers, low food security (LFS) with 2-4 positive answers, and very low food security (VLFS) with 5-6 positive answers [11,12].

Statistical Analysis and Sample Size Calculation

A sample size of 338 subjects was determined based on a previous study carried out in Iran[13] via G-power software with an α error of 0.05 and a power of 80% (1-β). The normality of data was determined by the Kolmogorov-Smirnov test. Moreover, independent samples t test, chi-square test, and stepwise multivariate linear regression were applied for data analysis using Statistical Package for Social Sciences (SPSS) with $P < 0.05$ considered acceptable threshold for significant level.

Results

The total prevalence of food insecurity and its different categories are presented in Table 1. Low food security and very low food security were prevalent among 18.34% and 12.72% of patients, respectively. Comparing the demographic data, female gender, larger family size, lower educational attainment, lower income, and non-employed status were identified as significant determinants of food insecurity among patients with NAFLD ($P < 0.05$; Table 2). Moreover, food-insecure patients had higher age, higher nutritional intake of grains and cereals, and lower consumption of fruits, vegetables, meat, and dairy products versus food-secure participants (Table 3). In stepwise multivariate regression model (Table 4), higher weight was a positive predictor of food insecurity ($P = 0.04$), while higher educational attainment and household income had protective effects against food insecurity ($P < 0.01$).

Discussion

This study found significant differences in age, gender, educational attainment and household economic status among food-secure and food-insecure patients with NAFLD. Specifically, NAFLD patients with food insecurity were mostly female and older with lower educational and socio-demographic levels. Moreover, these patients consumed more grains and fewer fruits, vegetables, and dairy products. Previous reports have established risk factors for food insecurity in different societies such as low educational attainment, low income, and high household size.[14] The findings of this study align with our previous research on food insecurity among the general population in Tabriz, Iran, as well as studies involving healthy school children and hospitalized children.[15,16] Although food insecurity in patients with NAFLD had not been previously evaluated, previous studies have confirmed the association between food insecurity and diabetes, metabolic syndrome, and cardiovascular disease.[17-20] Factors contributing to this association include poor dietary patterns, selecting cheap foods with high energy content, low vegetable and fiber intake, low socioeconomic status, race, and ethnicity.[21]

In our study, NAFLD patients with food insecurity

Table 1. The Prevalence of HFS, LFS, and VLFS among Patients With NAFLD

	No. (%)
HFS	233 (68.9)
LFS	62 (18.34)
VLFS	43 (12.72)
Total	338 (100)

Note. NAFLD: Non-alcoholic fatty liver disease; HFS: High food security; LFS: low food security; VLFS: Very low food security.

Table 2. General Demographic and Socioeconomic Characteristics of NAFLD Patients Based on Food Security Status

| Variable | NAFLD (N = 338) | | P |
	Food Secure (n = 227)	Food Insecure (n = 111)	
Gender, n (%)			
Male	128 (56.38)	51 (45.94)	0.03*
Female	99 (43.61)	60 (54.05)	
Age (Mean ± SD)	47.20 ± 10.65	49.90 ± 10.56	0.021*
Household size, No. (%)			
2-3	103 (45.37)	44 (39.63)	
4-5	106 (46.69)	49 (44.14)	<0.001*
≥6	18 (7.92)	18 (16.21)	
Household income (Rial[a])			
≤10000000	35 (15.62)	63 (56.45)	<0.001*
>10000000	192 (83.4)	48 (43.54)	
Marital status, No. (%)			
Single	3 (1.32)	2 (1.80)	
Married	188 (82.81)	84 (75.67)	0.08
Deceased spouse	23 (10.13)	16 (14.41)	
Divorced	13 (5.72)	9 (3.96)	
Education (y)			
No formal schooling	11 (4.84)	9 (8.10)	
Some schools	19 (8.37)	15 (13.51)	<0.001*
High school	55 (24.21)	50 (39.63)	
Diploma or more	142 (65.55)	37 (33.33)	
Smoking status, No. (%)			
Nonsmoker	106 (46.69)	48 (43.24)	0.12
Smoker	121 (53.30)	63 (56.75)	
Employment status			
Employed	118 (51.98)	34 (30.63)	<0.001*
Non-employed	109 (48.01)	77 (69.36)	

Note. NAFLD: Non-alcoholic fatty liver disease.
[a] Rial is the currency of Iran. 1 Rial is equal to 0.0000283502 Euros.
* Values provide the significance threshold.

Table 3. Nutritional Status and Dietary Intakes among NAFLD Patients Based on Their Food Security Status

| Variable | NAFLD (N = 338) | | P[a] |
	Food Secure (n = 227)	Food Insecure (n = 111)	
Age (Mean ± SD)	47.20 ± 10.65	49.90 ± 10.56	0.021*
Weight (kg)	79.66 ± 14.22	79.06 ± 16.34	0.72
Height (cm)	166.58 ± 16.01	165.73 ± 8.87	0.58
BMI (kg/m^2)	28.73 ± 5.29	29.45 ± 16.21	0.71
WC (cm)	102.12 ± 8.02	100.43 ± 7.05	0.92
Food groups (Serving/week)			
Grains/cereals	92.15 ± 4.75	121.63 ± 6.31	<0.001*
Fruits/vegetables	30.09 ± 15.42	27.38 ± 10.94	0.04
Meat/fish/legumes	33.68 ± 3.01	23.82 ± 1.20	0.002*
Milk/dairy products	24.11 ± 13.02	21.25 ± 10.11	0.030*

Note. NAFLD: Non-alcoholic fatty liver disease; SD: Standard deviation; BMI: Body mass index; WC: Waist circumference;
[a] Provided for the comparison of food secure and insecure groups by independent sample *t* test.
* Values provides the significance threshold.

Table 4. Stepwise Multivariate Linear Regression Analysis in NAFLD Patients

| Variable | NAFLD (N = 338) | | | |
	B	SE	β	P value
Age	0.013	0.013	1.01	0.31
Gender	0.26	0.28	1.29	0.36
Weight (kg)	0.024	0.012	1.02	0.049[a]
Height (cm)	-0.008	0.011	0.99	0.48
BMI (kg/m^2)	-0.013	0.02	0.98	0.52
Family size	0.088	0.09	1.09	0.34
Education	-0.30	0.11	0.75	0.006[a]
Household income (Rial*)	-1.12	0.18	0.33	<0.001[a]

Note. NAFLD: Non-alcoholic fatty liver disease; BMI: Body mass index; SE: Standard error;
[a] Rial is the currency of Iran. 1 Rial is equal to 0.0000283502 Euros.
* Values provide the significance threshold.

consumed more grains and cereals and fewer fruits, vegetables, and dairy products. Food insecurity can trigger the effects of poor dietary choices on NAFLD initiation and progression. Food insecurity by itself is associated with unhealthy food patterns. Berkowitz and colleagues' study indicated that food insecurity in poor low-income diabetic patients is associated with lower dietary quality, identified by a lower healthy eating index and lower fruits, vegetables, and legumes intake.[22] Most studies on food insecurity and dietary patterns obtained similar findings.[14,23] NAFLD is also associated with poor dietary choices and unhealthy eating patterns.[24] Therefore, the coexistence of NAFLD and food insecurity induces unhealthy dietary choices, as indicated in our findings.

The strength of the study lies in its investigation of the prevalence and determinants of food insecurity among patients with NAFLD, which is an important and understudied topic. The use of a multivariate linear regression model provides a comprehensive analysis of the factors associated with food insecurity. Comparing the dietary patterns of food-secure and food-insecure patients sheds light on the considerable effect of food insecurity on nutritional intake in NAFLD patients. However, limitations include reliance on self-reported data, which introduces recall bias, and the cross-sectional design, which limits causal inference. The study's specific geographic focus may restrict generalizability, and the omission of the severity or duration of NAFLD and a control group restricts the clinical insight into the association between NAFLD and food insecurity.

In conclusion, our findings revealed the potential determinant role of several demographic parameters such as gender, age, income, and educational attainment in predicting food insecurity in patients with NAFLD. Moreover, food-insecure patients with NAFLD had poor intakes of healthy food choices. More studies should be conducted to explore the determinants of food insecurity

in patients with NAFLD.

Conflict of interests declaration
The authors declare no conflict of interests.

Data availability statement
Data are available with reasonable request from corresponding author.

Author contributions
Conceptualization: Mahdieh Abbasalizad Farhangi, Fatemeh Abdi, Alireza Rahimi Mamaghani.
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Consent for publication
Not Applicable.

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